PULLEY TYPE CONSTANT VELOCITY JOINT

Field of the Invention

The present invention relates to constant velocity joints, and, more particularly, to a pulley type constant velocity joint which is capable of transmitting the rotational movement of an input shaft to an output shaft at the same velocity, and which is capable of adjusting the intersection angle of the input and output shafts within about 90°.

Background of the Invention

In general, since the wheels of an automobile are moved up and down while the automobile moves on the road, the angle between the wheel and a drive shaft is varied. A perspective view showing a conventional constant velocity joint is shown in FIG. 1, and a detailed perspective view showing the principal elements of the conventional constant velocity joint of FIG. 1 is shown in FIG. 2. As may be seen in these drawings, the conventional constant velocity joint includes input and output shafts 1 and 2 to be rotated by a driving force from the engine of an automobile, a Birfield joint 5 for adjusting the intersection angle of the input and output shafts 1 and 2, a Birfield joint boot 3, and a dust cover 7.

Here, the Birfield joint 5 includes an outer ring 11 to which the output shaft 2 is attached. The outer ring 11 is provided in its interior with an inner surface 12. Six guide grooves 13 are formed along the inner surface 12 of the outer ring 11 at regular intervals. The inner surface 12 is formed to have a truncated sphere shape.

An inner ring 14 connected with the input shaft 1 is inserted into the outer ring 11 and has an outer surface of a truncated sphere shape. A plurality of guide grooves 15 are formed along the outer surface of the inner ring 14 to correspond to the guide grooves 13 of the outer ring 11. Also, the center of the inner ring 14 has a hole 19 to be inserted on one end of the input shaft 1.

A plurality of balls (i.e., ball bearings) 16 are inserted into the spaces defined by the grooves 13 of the outer ring 11 and the grooves 15 of the inner ring 14. Additionally, a cage 18 having holes 17 corresponding to the number of the balls 16, or the number of the grooves 13 or 15 (e.g., six) which are regularly formed, is inserted between the outer ring 11 and the inner ring 14 to hold the balls 16 at the constant positions defined by the guide grooves 13 and 15. Each ball 16 is situated between opposite guide grooves 13 and 15 and holes 17 of the cage 18. The ball 16 is slidably rotated within the guide grooves 13 and 15.

The operation of the conventional constant velocity joint as described above will now be described. Each ball 16 is situated at a constant position within two opposite guide grooves 13 and 15 when the input shaft 1 is aligned with the output shaft 2, and the ball 16 is slidably situated at a position different from the constant position within the guide

grooves 13 and 15 when the input shaft 1 is not aligned with the output shaft 2. Therefore, the balls 16 flexibly transmit power from the input shaft 1 to the output shaft 2 even though the axis of the two shafts 1 and 2 are not aligned with each other.

In such a case, the inner ring 14 and the outer ring 16 are brought into contact with one point of each ball 16, respectively. Furthermore, the rotating force of the inner ring 14 is transmitted to the balls 16 through the contact points between the inner ring 14 and the balls 16, and the rotating force transmitted to the balls 16 is transmitted to the outer ring 11 through the contact points between the outer ring 11 and the balls 16.

In the conventional constant velocity joint described above, the inner and outer rings 14 and 11 may become fatigue-fractured due to the concentration of stress on the contact points, and stress may well be excessively concentrated on the balls 16. In addition, the conventional constant velocity joint typically includes contact portions and guide grooves 11 and 15, which make fabrication of the joint difficult and the structure of the joint complicated.

Moreover, the conventional constant velocity joint can allow a maximum 46.5° as the intersection angle of the input and output shafts at which the balls 16 may be kept stably within the guide grooves 13 and 15 and at which power can be transmitted from the input shaft 1 to the output shaft 2. Thus, the conventional constant velocity joint can only be used for an intersection angle of less than 46.5°.

Summary of the Invention

An object of the present invention is to

provide a pulley type constant velocity joint in which an elongate member or wire is wound around the circumferential grooves of two pulleys, thereby allowing the range of the intersection angle of input and output shafts to be maximized while transmitting the axial rotating velocity of the input shaft to the output shaft.

Another object of the present invention is to provide a pulley type constant velocity joint in which the wire is wound around the circumferential grooves of the pulleys to allow the input and output shafts to maintain bilateral symmetry with each other and to transmit the axial rotation velocity of the input shaft to the output shaft to cause the structure of the joint to be relatively simple.

A further object of the present invention is to provide a pulley type constant velocity joint in which the wire is wound around the circumferential grooves of the pulleys to transmit the axial rotation velocity of the input shaft to the output shaft and reduce the failure rate of the joint.

To accomplish the above objects, the present invention provides a pulley type constant velocity joint which may include first and second shafts for transmitting and receiving power therebetween, first and second pulleys being fixedly attached to the ends of the first and second shafts, respectively, and a wire wound around the circumferential grooves of the first and second pulleys to allow the first and second pulleys to be rotated with reference to the center of the first and second pulleys. Furthermore, first and second support frames may also be included for rotatably supporting each center of the first and second pulleys, both ends of which are rotatably connected with each other. The pulley type constant

velocity joint may also include two rotating pins to rotatably connect with the first and second pulleys and the frames at the centers of the first and second pulleys, and two connecting pins for connecting the first and the second frames at their ends and for allowing the frames to rotate according to the rotation of the first and second shafts.

The present invention also relates to a pulley type constant velocity joint which may include first and second shafts for transmitting and receiving power therebetween, first and second pulleys being fixedly attached to each end of said first and second shafts and symmetrically rotating with respect to each center thereof as a first degree of freedom, and a wire wound around the circumferential grooves of the first and second pulleys to symmetrically rotate the first and second pulleys with reference to each of the centers. Additionally, first and second support frames may be included for rotatably supporting each center of the first and second pulleys and rotatably connecting both ends thereof as a second degree of freedom.

Further, the present invention also provides a pulley type constant velocity joint which may include first and second shafts, first and second pulleys, and a wire to make the first and second shafts have a first degree of freedom and transmit and receive power therebetween. In addition, first and second support frames may be included to make the first and second shafts have a second degree of freedom and transmit and receive power therebetween.

Brief Description of the Drawings

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed

description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view showing the construction of a prior art constant velocity joint;

FIG. 2 is a detailed perspective view showing the construction of the principal elements of the prior art constant velocity joint of FIG. 1;

FIG. 3 is a front view showing the construction of a pulley type constant velocity joint in accordance with the present invention;

FIG. 4 is a plan view showing the construction of the pulley type constant velocity joint of the present invention;

FIG. 5 is a front view showing the state in which force is applied to the first shaft in a Y-axis direction and the first and second shafts are rotated; and

FIG. 6 is a plan view showing the state in which force is applied to the first shaft in Z-axis direction and the first and second shafts are rotated.

Description of the Preferred Embodiments

Turning now to FIGS. 3 and 4, FIG. 3 is a front view showing the construction of a pulley type constant velocity joint in accordance with the present invention, and FIG. 4 is a plan view showing the construction of the pulley type constant velocity joint of FIG. 3. As illustrated in the drawings, the pulley type constant velocity joint 100 of the present invention includes first and second shafts 200 and 210 as input and output shafts, respectively, first and second support frames 400 and 410 for allowing the first and second shafts 200 and 210 to be rotated around rotating pins 250, and two connecting pins 450 for connecting the first and second support frames 400

and 410 to allow them to be rotated relative to each other.

Two pulleys 300 and 310 are fixedly attached to the inner ends of the first and second shafts 200 and 210. An elongate member or wire 500 is wound around the circumferential grooves of the pulleys 300 and 310 to cross itself and is fixed at predetermined positions on the pulleys, respectively. Accordingly, if the first shaft 200 is rotated around one rotating pin 250A, the second shaft 210 is rotated around the other rotating pin 250B at the same time. Therefore, the first and second shafts 200 and 210 maintain bilateral symmetry with each other at all times. Here, the wire 500 is preferably made of metal to enhance its durability.

The first pulley 300 is fixedly attached to the inner end of the first shaft 200, which functions as an input shaft, while the second pulley 310 is fixedly attached to the inner end of the second shaft 210, which functions as an output shaft. The first pulley 300 is rotatably supported by the first support frame 400 at the center of the first support frame 400, while the second pulley 310 is rotatably supported by the second support frame 410 at the center of the second support frame 410. In such a case, a plurality of through holes are formed through the centers of the first and second pulleys 300 and 310 and the centers of the first and second frames 400 and 410, and the rotating pins 250A and 250B are inserted into the through holes.

Each of the first and second pulleys 300 and 310 has a disk shape, and each of the first and second support frames 400 and 410 has an arc shape. The disk-shaped pulleys 300 and 310 are rotatably attached at their centers to the support frames 400 and 410 by the

rotating pins 250. Two couples of neighboring ends of the support frames 400 and 410 are connected by the connecting pins 450 to allow them to be rotated, respectively. The first and second pulleys 300 and 310 are secured in place by the first and second support frames 400 and 410, and are capable of being rotated around the rotating pins 250.

The wire 500 is wound around the circumferential grooves of the first and second pulleys 300 and 310 to cross itself to form a figure-eight loop. By the wire 500, when the first pulley 300 is rotated, the second pulley 310 is rotated at the same rate in the opposite direction, thereby causing the rotation of the first and second pulleys 300 and 310 to be symmetric. Accordingly, the first shaft 200 attached to the first pulley 300 and the second shaft 210 attached to the second pulley 310 are symmetrically rotated.

In this case, the wire 500 is preferably fixed to the inner ends of the first and second shafts 200 and 210 to prevent the wire 500 from slipping on the circumferential grooves of the first and second pulleys 300 and 310. Two holding portions 460 are formed on both ends of each connecting pin 450, which connect the first and second support frames 400 and 410 to prevent the connecting pins 450 from being removed from the first and second support frames 400 and 410.

The operation of the pulley type constant velocity joint of the present invention will now be explained with reference to FIGS. 5 and 6. More particularly, FIG. 5 is a front view of a state in which force is applied to the first shaft 200 in the Y-axis direction and the first and second shafts 200 and 210 are rotated. Similarly, FIG. 6 is a plan view showing the state in which force is applied to the

first shaft 200 in the Z-axis direction and the first and second shafts 200 and 210 are rotated.

The pulley type constant velocity joint 100 of the present invention is situated at a position where the first and second shafts 200 and 210 are connected to each other. It should be noted here that the intersection angles of the first and second shafts 200 and 210 are described relative to the XYZ axis orientation provided in FIG. 3.

When force is applied to the outer end of the first shaft 200 in the Y-axis direction, the first pulley 300 attached to the inner end of the first shaft 200 is rotated in the direction opposite that of the first shaft 200. Additionally, the second pulley 310 is rotated in the same direction as the first shaft 200, and the second shaft 210 is rotated in the direction opposite to that of the first shaft 200. As a result, the second shaft 210 is rotated at the same angle as that at which the first shaft 200 is rotated. Each of the upper and lower intersection angles is divided into two equal angles by the line connecting the connecting pins 450.

Thereafter, when force is applied in the Z-axis direction, operation of the pulley type constant velocity joint is as follows. When force is applied to the outer end of the first shaft 200 in the Z-axis direction, the portion of the wire 500 between the first and second pulleys 300 and 310 is bent in the Z-axis direction and, at the same time, the first support frame 400 near the first shaft 200 is rotated in the same direction as that of the first shaft 200.

In this case, as the first shaft 200 is rotated, the axis connecting the two connecting pins 450 is situated on the plane dividing the intersection angle of the first and second support frames 400 and

410 into two equal angles. As described above, each of the first and second shafts 200 and 210 has two degrees of freedom in the X and Y-axes.

Next, when a driving force is applied to the first shaft 200, the operation of the pulley type constant velocity joint is as follows. The plane bisecting the supporting frames 400 and 410 passes through the connecting pins 450. This bisecting plane is always the plane of symmetry of the constant velocity joint 100. Accordingly, the first and second shafts 200 and 210 are always moving in symmetry with respect to this bisecting plane, which is also the plane of symmetry. This symmetricalness includes the axial rotations of the first and second shafts 200 and 210. That is, the first and second shafts 200 and 210 axially rotate in the same angular velocity no matter what the angle is between the first and second shafts 200 and 210.

As described above, the present invention provides a pulley type constant velocity joint in which the wire 500 is wound around the circumferential grooves of the pulleys 300 and 310 to cross itself. Thus, the first and second pulleys 300 and 310 are operated in conjunction with each other. This thereby allows the input and output shafts to be symmetrically situated and causes the rotational movement of the input shaft to be transmitted to the output shaft at the same velocity.

In contrast to the conventional constant velocity joint of the prior art, the pulley type constant velocity joint of the present invention has a relatively simple structure in which the wire 500 is wound around the circumferential grooves of the pulleys 300 and 310. Accordingly, the pulley type constant

velocity joint has a low failure rate due to its relatively simple structure.

Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible without departing from the scope and spirit of the invention as disclosed in the accompanying claims.